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A BIOLOGICAL EVALUATION OF WHITE PINE BLISTER RUST ON PORTIONS OF THE COVELO RANGER DISTRICT, MENDOCINO NATIONAL FOREST

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ABSTRACT

A sugar pine plantation and portions of mixed conifer forest on the Covelo Ranger District were evaluated for present and potential levels of white pine blister rust infection on sugar pines. Incidence and impact of the disease in areas examined were low. Management strategies available to reduce or mitigate possible future impacts of the disease on the sugar pine resource are discussed.

INTRODUCTION

In response to a request for a biological evaluation from Floyd Barney, District Silviculturist, Covelo Ranger District, I and entomologist John Wenz examined portions of the District on July 15 and 16, 1982. The objectives of the evaluation were to determine present and potential levels of white pine blister rust in areas where Floyd had observed branch flagging and stem girdling on sugar pines caused by the disease, and to present management alternatives which would reduce or mitigate the current and potential impact of the disease.

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OBSERVATIONS

Five areas of concern were examined. These were the Buck Rock sugar pine plantation, three areas of mixed conifer forest along road 23N01 east of Hammerhorn Lake, and a mixed conifer forest at the end of road 25N15B (Georges Valley). Sugar pines along the roads between the five areas were also examined for signs and symptoms of blister rust infection.

The Buck Rock plantation is within a mixed conifer forest near Beaver Creek that was clearcut and planted to sugar pine (10X10 ft spacing) in 1971. Most of the plantation is on a 20-30% slope with a north aspect, facing Beaver Creek. Trees range in height from 2 to 20 feet, with the suppressed height growth due to severe brush (mostly whitethorn) competition. Blister rust was scattered throughout the plantation, but less than 1% of the trees were infected. The heaviest concentration of rust was in one pocket in the lowest portion (closest to stream influence) of the plantation where five trees had branch and bole cankers. The numbers of visible cankers decreased upslope. The few cankers that were present in mid and upper portions of the plantation were usually on branches and were more than 24 inches from the main bole. Three trees had broken off at bole cankers. Occasional small (2 to 4 feet in height) sugar pines had a single or a few dead branches. These flagged branches were mechanically broken at the main bole, possibly from snow, and were not associated with rust infection. Almost all (18 of 20) cankers we aged were found on 6-year-old wood, indicating that most infection took place in 1976, a year very favorable for blister rust. Blister rust was present on a few of the Ribes present in the plantation.

Rust cankers were present, at low levels, on natural sugar pine saplings and poles along the road (24N06) to the plantation and were somewhat more frequent along portions of the road near Fishtown and Buck Rock Creeks. Most of the cankers were prunable branch cankers. Those that were aged were on 6-year-old wood.

Blister rust was also observed along Road 23N01 from Hammerhorn Lake to Sheep Ridge. Again, the numbers of infected sugar pines were few and infected trees had only one or a few, mostly nonlethal, branch cankers. Two infected sugar pine saplings were noted in the Georges Valley area, one with a bole canker and one with a nonlethal branch canker. Three of five cankers aged in these areas were on 6-year-old wood and two were on 5-year-old wood.

Sugar pines in one location between the Indian Dick Station and the turnoff to road 25N15B had flagged branch tips resulting from undetermined cause or causes. Although the flagging superficially resembled rust infection, typical branch swellings or fruiting bodies of the fungus were not present. Scale insects were present on necrotic needles, but not in sufficient numbers to have been responsible for the flagging.

BIOLOGY OF THE PEST

White pine blister rust is caused by the fungus Cronartium ribicola, an obligate parasite that attacks sugar and western white pines and several species of Ribes. The fungus needs the two alternate hosts to survive, spending part of its life on 5-needled pines and the other on Ribes. Infection of pines results in branch mortality, top kill, and tree mortality.

Spores produced by the fungus in the spring on pine bole or branch cankers are wind-disseminated to Ribes were they infect the leaves. Spores produced in orange pustules on the underside of the leaves reinfect Ribes throughout the summer, resulting in an intensification of the rust. Another spore stage forms on Ribes leaves in the fall. These spores are wind-disseminated to pines and infect current year needles. Following infection, the fungus grows from the needle into the branch and forms a canker. After 2 or 3 years, spores are produced on the cankers and are spread to Ribes to continue the cycle. Although blister rust may spread hundreds of miles from pines to Ribes its spread from Ribes back to pines is usually limited to a few hundred feet.

Branch cankers continue to enlarge as the fungus invades additional tissues and moves toward the bole. Branch cankers within 24 inches of the bole will eventually form bole cankers. Bole cankers result in girdling and death of the tree above the canker. Cankers whose closest margins are more than 24 inches from the main bole are unlikely to reach the bole and only branch flagging will occur.

Environmental conditions are critical during the infection processes and limit the disease most years. Moisture and low temperatures favor infection of both hosts, and must coincide with spore dispersal for infection to occur. In California, these conditions occur only infrequently, usually in cool moist sites such as stream bottoms or around meadows. When these favorable years (wave years) occur, high levels of infection can result. Wave years have occurred at approximately ten year intervals in the past. As one moves from sites most favorable for rust to less favorable sites, the frequency of wave years decreases.

MANAGEMENT STRATEGIES

Current incidence and impact of white pine blister rust are low in areas of the Covelo District we examined and will probably remain low unless a series of favorable wave years occur and/or the planting of sugar pines in areas favorable for rust increases. Nevertheless, various strategies are available to the resource manager to reduce or mitigate current and potential impacts of the disease on the sugar pine resource.

Management of Existing Sugar Pine

1. Plantations. The presence of the rust in existing sugar pine plantations does not preclude continued management for the species. Sugar pines with bole cankers or with branch cankers within 4 inches of

the bole are lethally infected and should be removed in a sanitation thinning or in conjunction with regularly scheduled thinning. Non-lethally infected trees (those without bole cankers and with no branch cankers within 4 inches of the bole) could be pruned of all branches from the ground up to about 12 feet on larger trees and pruned to leave a 30% live crown ratio on smaller trees. Pruning of branch cankers will prevent the fungus from reaching the bole and killing the tree. Most blister rust infections occur within 16 feet of the ground because of favorable microclimatic conditions. Pruning of all lower branches removes the needle-bearing surface of the tree that is most vulnerable to infection. Pruning is expensive and in lightly infected plantations such as Buck Rock it may be more efficient to remove only cankered branches.

Reducing levels of brush competition in young plantations will reduce the risk and impact of future blister rust infections. Because most infections occur near the ground, trees held back in height growth will remain susceptible to rust infection for a longer time period than trees growing without competition.

2. Natural stands. The levels of blister rust we observed in natural stands on the Covelo District were so low that control measures are probably not economically warranted. In stands were incidence of rust is higher and maintainence of sugar pine as a stand component is desirable, cultural control strategies -- including sanitation thinning, the recognition and removal of lethally infected sugar pines during pre-commerical thinnings, and pruning -- may be used.

Future Sugar Pine Regeneration

Forest sites vary greatly in suitability for blister rust occurrence and intensification. The 1976 wave year was, in some respects, beneficial to the Covelo District because it delimited areas where rust would occur when environmental conditions are especially favorable. The most useful indicator of future rust potential for a particular site is the level of rust that is currently present.

The rust potential, or rust hazard, of a particular site is determined by 1) the topography, which influences the microclimatic conditions present, and by 2) the presence or absence of the hosts, sugar pine and Ribes. Three levels of rust hazard — low, moderate, and high — can be distinguished. Low hazard sites are those where either sugar pine, Ribes, or both are absent or where the environment is generally unfavorable for infection of the host by the fungus. Unfavorable environments would include dry mid slope or ridge top areas away from the influence of stream bottoms or wet meadows. Sugar pines could be planted on low hazard sites with little risk of subsequent infection. High hazard sites are those where climatic conditions are favorable for rust incidence, as in moist, stream bottom sites, and where blister rust is present on sugar pines and/or Ribes. Sugar pines susceptible to the disease should not be planted on sites where the blister rust is now present. Rust infections will occur sporadically on these high hazard sites during favorable rust years. Rust resistant sugar pines could be planted with little risk of infection. Moderate hazard sites possess a

the bole are lethally infected and should be removed in a sanitation thinning or in conjunction with regularly scheduled thinning. Non-lethally infected trees, those without bole cankers and with no branch cankers within 4 inches of the bole, could be pruned of all branches from the ground up to about 12 feet on larger trees and pruned to leave a 50% live crown ratio on smaller trees. Pruning of branch cankers will prevent the fungus from reaching the bole and killing the tree. Most blister rust infections occur within 15 feet of the ground because of favorable microclimatic conditions. Pruning of all lower branches removes the needle-bearing surface of the tree that is most vulnerable to infection. Pruning is expensive and in lightly infected plantations such as Buck Rock it may be more efficient to remove only cankered branches. (7)

Reducing levels of brush competition in young plantations will reduce the rate and impact of future blister rust infections. Because most infections occur near the ground, trees held back in height growth will remain susceptible to rust infection for a longer time period than trees growing without competition.

2. Natural stands. The levels of blister rust we observed in natural stands on the Covelo District were so low that control measures are probably not economically warranted. In stands where incidence of rust is higher and maintenance of sugar pine as a stand component is desirable, cultural control strategies -- including sanitation thinning, the recognition and removal of lethally infected sugar pines during precommercial thinnings, and pruning -- may be used.

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wide gradation of characteristics, such as cool, moist sites where sugar pines and Ribes are not now infected, or mid-to-upper slope sites were rust is present, but at low levels. Management strategies should be developed on the basis of site characteristics and District objectives. Strategies on moderate hazard sites include realizing the potential risk in managing sugar pine, planting a mix of species rather than pure sugar pine, increasing stocking levels to minimize potential loss, and reducing brush competition.

Continued surveillance will provide the District with a record of blister rust locations. These records, preferably on stand record cards, should help avoid costly mistakes by preventing the establishment of sugar pine plantations on high risk sites.

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